STS 113/11A: Assessment of Air Quality in the International Space Station (ISS) and Space Shuttle Based on Samples Returned in December 2002 and in May 2003 aboard Soyuz 5

The toxicological assessments of grab sample canisters (GSCs) returned aboard STS-113 and Soyuz 5 are reported. Analytical methods have not changed from earlier reports. Surrogate standard recoveries from the GSCs were 79-120% except as noted in the table. One sample was returned with the valve opened.

The two general criteria used to assess air quality are the total-non-methane-volatile organic hydrocarbons (NMVOCs) and the total T-value (minus the CO_2 and formaldehyde contributions). Control of atmospheric alcohols is important to the water recovery system engineers, hence total alcohols (including acetone) are also shown for each sample. Octafluoropropane (OFP) has leaked from heat-exchange units in large quantities, so its concentration is tracked separately. Because formaldehyde is quantified from sorbent badges, its concentration is also listed separately. These five indices of air quality are summarized below:

Sample Location	Date	NMVOCs - OFP (mg/m^3)	OFP (mg/m^3)	T Value[a] (units)	Alcohols (mg/m^3)	Formaldehyde (mg/m^3)
Lab GSC/For.	10/20/02	*"defective" sampler*				**0.055**
FGB GSC	10/20/02	11	13	0.57	6.2	ns[c]
SM GSC/For.	10/20/02	*valve open upon return to JSC*				0.028
Lab GSC	10/21/02	11	16	0.69	5.1	ns
Airlock GSC	10/22/02	9	13	0.55	6.0	ns
Lab GSC/For.	11/15/02	12	12	0.46	8.6	0.046
SM GSC/For.	11/15/02	12	11	0.65	8.2	0.022
Lab GSC[d]	11/29/02	8	4	0.49	3.1	ns
Lab GSC/For.	12/16/02	10	1	0.50	6.0	**0.057**
SM For.	12/16/02	--	--	--	--	0.027
Lab For.	01/22/03	--	--	--	--	**0.057**
SM For.	01/22/03	--	--	--	--	0.020
Lab For.	02/26/03	--	--	--	--	0.040
Lab For.	04/02/03	--	--	--	--	0.041
Lab For.	04/23/03	--	--	--	--	0.041
Shuttle Preflight	11/23/02	2	n/a[b]	0.20[e]	0.5	ns
Shuttle Middeck	12/04/02	11	8	0.58	5.8	ns
Acceptable Guideline:		<25	85000	<1	<5	0.050

[a] Formaldehyde and CO2 not included in T calculation.
[b] n/a = not in analysis plan
[c] ns = no sample available
[d] one surrogate standard was 2 % below the acceptable range
[e] The unusually high value was caused by a mixture of aldehydes and ketones found at very low levels in the sample.

The table shows that the air quality in general was acceptable for crew respiration through the middle of December 2002. No conclusions can be made about the air quality after that date due to NASA's inability to return air samples from the ISS. Alcohols are not being controlled to the recently lowered guideline of 5 mg/m^3, which was recommended to protect the water recovery systems. The airlock sample was taken during the regeneration of Metox canisters in the adjacent Node. The trace pollutants were not increased above background; however, inspection of table 1 in the appendix shows a CO_2 concentration of 17,000 mg/m^3, which is a relatively high concentration, but still below the 24-hour

SMAC of 23,000 mg/m^3. The control of OFP continues to be adequate at least through December 2002.

Formaldehyde concentrations suggest that the high levels that were being found in the Lab atmosphere have subsided. This is probably attributable to the restoration of IMV in early February 2003. Before the obstructing material was removed from ducts, the Lab formaldehyde concentrations approached 0.06 mg/m^3, whereas after the repair, the levels were near 0.04 mg/m^3. This does not mean that local sources in the Lab have been reduced, only that the excess of formaldehyde produced in the Lab is distributed into the whole volume of the ISS.

Enclosures
1: Analytical Results of STS-113/11A and ISS Lab sample returned on Soyuz 5
2: T Values of STS-113/11A and ISS Lab sample returned on Soyuz